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(11) Publication number : **0 472 425 A2**

(12)

## EUROPEAN PATENT APPLICATION

(21) Application number : **91307711.1**

(51) Int. Cl.<sup>5</sup> : **B60C 9/22, B60C 9/20**

(22) Date of filing : **21.08.91**

(30) Priority : **24.08.90 JP 223392/90**  
**16.07.91 JP 202332/91**

(43) Date of publication of application :  
**26.02.92 Bulletin 92/09**

(84) Designated Contracting States :  
**DE FR GB**

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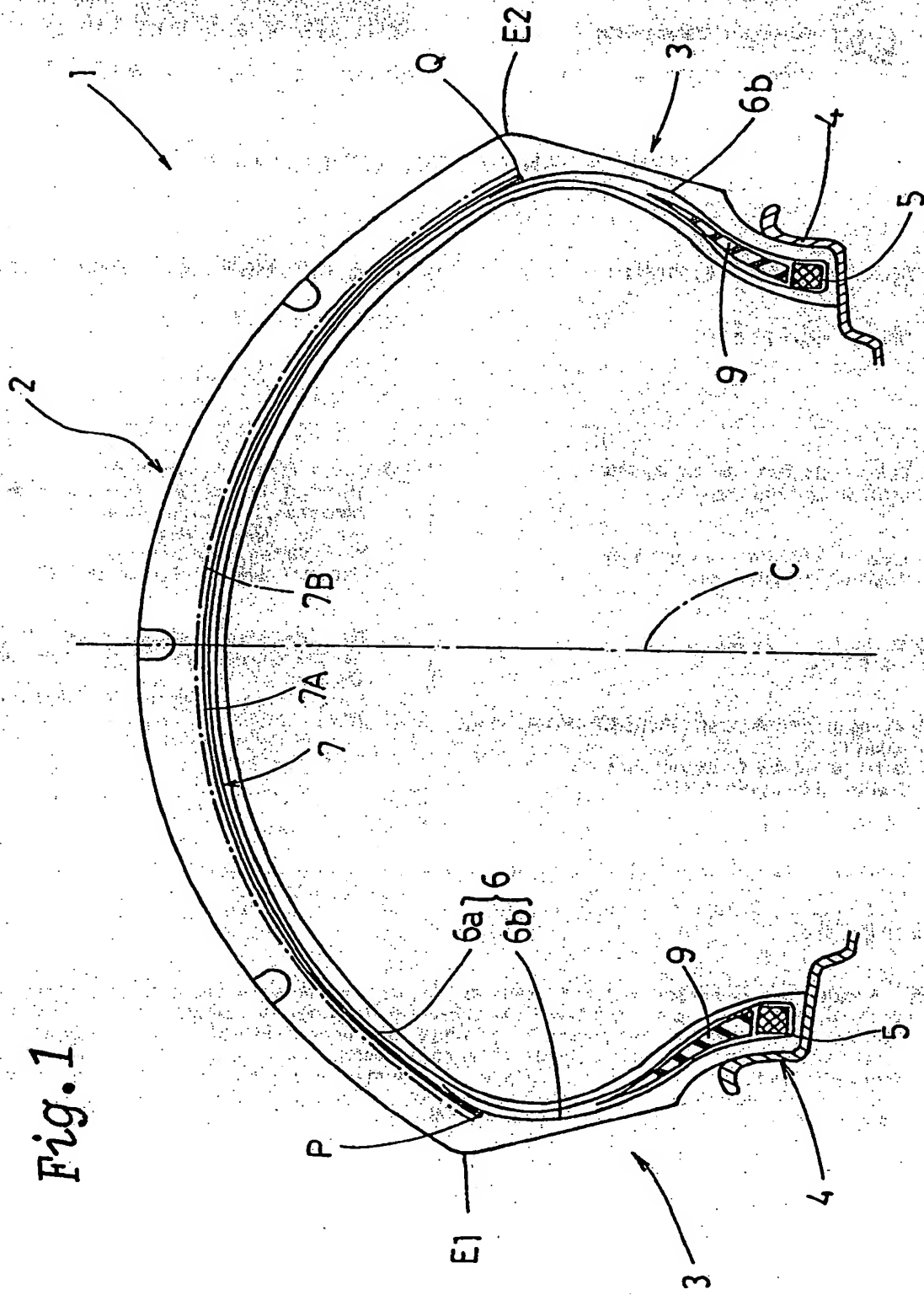
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(54) Radial tyre.

(57) A radial tyre comprising a toroidal carcass (6) extending between beads (4) and turned up around bead cores (5), and a belt reinforcement disposed radially outside the carcass (6) and inside a tread (2), characterised in that said belt reinforcement comprises a band layer (7) formed by plural ribbons (10) of rubber in which one cord or two parallel cords are embedded, the ribbons (10) being wound spirally and arranged side by side, the ends of the ribbons (10) being located at the edges (P,Q) of the band layer (7), and at each of said edges (P,Q) of the band layer (7) the ends of the ribbons (10) being shifted or spaced apart equally in the circumferential direction of the tyre.

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Fig. 1



The present invention relates to a belted radial ply tyre, and more particularly an improvement in the belt structure.

To provide a strong hoop reinforcement for a tyre tread region, belt reinforcements known as the "endless band" type made of spirally wound cords have been proposed.

In Japanese Patent Publication No.51-55505 (JP-4-51-55505), such a belt reinforcement for a tyre is disclosed. The belt is formed by spirally winding a ribbon of rubber, in which reinforcing cords are embedded, around the carcass. In the ribbon at least 8 cords are embedded, and the width of the ribbon is 5 to 50 mm. Such a ribbon has relatively wide ends each of which cause a large localised change in the belt rigidity in the circumferential direction of the tyre.

In Japanese Patent Publication No.61-85203 (JP-A-61-85203), a belt reinforcement formed by spirally winding two ribbons is disclosed. Therefore, in comparison with the above-mentioned belt, the time to make the belt can be reduced. However, as the two ribbons are wound each from the tyre equator toward one tread edge, two ribbon ends are placed at the tyre equator, and one end is placed in each tread edge portion. Those four ends each locally change the belt rigidity and disturb the tyre uniformity.

Especially, in motorcycle tyres which are used at high speed, such an unbalanced arrangement becomes a serious problem. For example, deterioration in the running stability especially during cornering, deterioration in ride comfort and the like.

It is therefore, an object of the present invention to provide a radial tyre in which tread rigidity is reduced.

According to one aspect of the present invention, a radial tyre comprises a toroidal carcass extending between beads and turned up around bead cores, and a belt reinforcement disposed radially outside the carcass and inside a tread, wherein the belt reinforcement comprises a band layer formed by plural ribbons of rubber in which one cord or two parallel cords are embedded, the ribbons are wound spirally to be arranged side by side, the ends of the ribbons are located at the edges of the band layer, and at each of said edges of the band layer the ends of the ribbons are shifted equally in the circumferential direction of the tyre around the axis of the tyre.

Preferably the ribbons are wound continuously from one edge to the other edge of the tread.

The belt reinforcement may comprise at least two plies and a band layer over said two plies.

Embodiments of the present invention will now be described by way of example only in conjunction with the accompanying drawings, in which:

Fig.1 is a cross sectional view of a motorcycle radial tyre according to the present invention;

Fig.2 is an enlarged perspective view of a ribbon;

Fig.3 is a sectional view of a method of winding the ribbons or belt cords;

Fig.4 is a schematic plan view of the band layer separately showing the spirally wound arrangement of the ribbons;

Fig.5 is a perspective view of the separated band cords to show the positions of the ends thereof; and

Fig.6 is a cross sectional view of a radial tyre for four-wheeled vehicle showing another embodiment of the present invention.

In Figs.1 to 5, a motorcycle radial embodiment tyre 1 has a tread 2, axially spaced bead portions 4, and sidewalls 3 extending radially inwardly from the tread edges to the bead portions 4. A bead core 5 is disposed in each bead portion 4, and a carcass 6 extends between the bead portions 4 around the tyre and having edges turned up around the bead cores 5 from the axially inside to the outside thereof to form two turned up portions 6b and one main portion 6a therebetween.

A bead apex 9 is disposed in each bead portion 4 between each turned up portion 6b and the main portion 6a of the carcass, said apex 9 extends radially outwardly and taperingly from the bead core 5.

The bead 2 is reinforced by a belt reinforcement composed of only a band layer 7 disposed radially outside the carcass 6.

The tread 2 is curved so as to have a single radius of curvature and extends so that the tread width between the tread edges E1 and E2 is the maximum width of the tyre.

The carcass 6 comprises at least one ply, in this embodiment one ply, of cords arranged radially of the tyre at an angle of 60 to 90 degrees with respect to the tyre equator C.

For the carcass cords, organic fibre cords, e.g. nylon, rayon, polyester, aromatic polyamide or the like can be used. In this embodiment nylon fibre cords are used.

The edge of each turned up portion 6b of the carcass 6 is extended into the tread shoulder portion to be secured between the band edge and the carcass 6a.

The band layer 7 is formed on the radially outside the carcass 6a by spirally winding ribbons 10 around the carcass 6a.

In the ribbon 10, a single cord or two parallel cords 11 are embedded in covering rubber 12 along the length of the ribbon as shown in Fig.2.

For the band cords 11, organic fibre cords, e.g. nylon, aromatic polyamide, polyester or the like, and/or steel cords can be used.

Preferably, a cord having a modulus of not less than 600 kgf/sq.mm is used.

The ribbon 10 in this example in which one cord is embedded has a rectangular sectional shape.

To make the band 7, plural ribbons 10 are wound spirally while being drawn up in plural lines.

Thus a plurality of ribbons are wound mutually parallel.

For example, as shown in Figs.3-5, two ribbons 10A and 10B, in which one cord is embedded, are wound simultaneously and continuously from points P near one tread edge E1 to points Q near the other tread edge E2 across the tyre equator C in the same winding direction.

Further, the ribbons are wound so as to lie closely together to form a continuous-sheet-like band layer.

The ends F1 and F2 of the ribbons 10A and 10B located in each tread edge region are shifted or displaced so that they are spaced apart equally in the circumferential direction of the tyre around the axis of the tyre as shown in Fig.4.

In this example the pitch angles which angles give the circumferential positions for the ribbon ends are 180 degrees. If three ribbons are used, the pitch angles are 120 degrees; and if four, 90 degrees.

By circumferentially shifting the ends, the small fluctuations of rigidity are distributed around the tyre.

As the belt reinforcement in this embodiment is composed of only one band layer, the bending rigidity of the tread portion 2 is minimised, while providing a strong hoop effect. Thus the ride comfort, high speed durability and running stability are improved, while the camber stiffness which is required for cornering of a motorcycle is improved.

Test tyres of size 170/60R 17 having the tyre structure shown in Fig.1 and detail specifications shown in Table 1 were made and tested for the following performance properties.

#### High-speed Durability

The test the running speed was increased every 20 minutes in steps of 10 km/H from an initial speed of 160 km/H. The speed at which any tread failure occurred was measured as the high speed durability. The test was carried out at maximum load and at regular pressure, the test being as specified in JIS (Japanese Industrial Standard), using a drum tyre tester.

The results are indicated as an index based on the assumption that the reference tyre 1 is 100. The larger the value, the better the durability.

#### Wear Resistance

Using a drum tester, running at a speed of 80 km/H under 150% of the maximum load and at the regular pressure specified in JIS, the total running distance till the amount of wear reached to 30% of the groove depth of the tread grooves formed in the tread central region, was measured. The results are indicated by an index based on the assumption that the reference tyre 1 is 100. The larger the value, the better the wear resistance.

#### Manoeuvrability and Ride comfort

While running a motorcycle on a straight course at 260 km/H and on a 400m radius course at 220 km/H, manoeuvrability and ride comfort were evaluated by a test driver.

The results are indicated by an index. The larger the value, the better the resistance.

#### Camber Stiffness

While changing the camber angle to be 8, 16, 24, 32 and 40 degrees, the camber thrust was measured at an inflation pressure of 2.9 kgf/sq.cm and a tyre load of 145 kg, and the camber stiffness at each camber angle was computed therefrom, and then the mean value thereof was also computed. The mean values for the respective tyres are indicated by an index. the larger the ind x, the better the performance.

#### Band making Time

The time required to make the band of each test tyre exclusive of time for incidental works, is indicated by an index based on the assumption that the reference tyre 2 is 100.

Thus as apparent from the test results, the working example motorcycle tyres were improved in high speed durability, ride comfort, manoeuvrability and running stability in comparison with the reference tyres.

Next a four wheel vehicle embodiment will be described in relation to Fig. 6 in which a carcass 6 extends between bead portions 4 through a tread 2 and sidewalls 3 being turned up around bead cores 5 from the axially inside to outside thereof to form two turned up portions 6b and a main portion 6a therebetween. The carcass 6 comprises at least one ply, in this embodiment one ply, of cords arranged radially at an angle of 60 to 90 degrees with respect to the tyre equator C.

For the carcass cords, the above-mentioned organic fibre cords or steel cords may be used.

In this embodiment, the belt reinforcement further includes a breaker 8 in addition to a band layer 7 having a similar structure to the above.

The breaker 8 is disposed radially outside the carcass 6, and the band 7 is disposed radially outside the breaker 8.

The breaker 8 comprises at least 2 plies, in this embodiment 2 plies 8a and 8b, of parallel cords laid at 15 to 70 degrees with respect to the tyre equator C so that the cords in each ply cross the cords of the other ply.

For the breaker cords, organic fibre cords, e.g. nylon, rayon, polyester, aromatic polyamide or the like, and/or steel cords may be used.

The width BW of the breaker 8 is 0.8 to 0.95 times the tread width TW.

The band 7 in this embodiment is formed by winding ribbons spirally around the breaker so as to completely cover the outside of the breaker 8. The band width is larger than the breaker width BW. Therefore, breaker edge separation or looseness is effectively prevented, and the durability of the tread portion 2 is improved.

The ribbons may be wound in the same manner as the above-mentioned embodiment. The ends of the ribbons are equally shifted and spaced apart in the circumferential direction of the tyre at each edge of the band.

Incidentally, in the motorcycle tyre 1 of the first embodiment the belt reinforcement may include a breaker as in the second embodiment. Further, in the radial tyre 1A for a four-wheeled vehicle, the breaker layer 8 may be omitted from the belt reinforcement.

Further, the band 7 may be provided with a two-layered structure by disposing a layer 7B of wound ribbons radially outside the innermost layer 7A as shown in Fig. 1 by a chain line. In this case, the winding direction in the outer layer 7B may be reversed to that in the inner layer 7A.

The ends of all of the ribbons in the outer and inner layers are equally shifted or spaced in the circumferential direction around the tyre. Further, when ribbons in the same number, for example two ribbons, are used in each layer, the shifting or spacing is preferably such that the ends of the ribbons in the inner layer and the ends of the ribbons in the outer layer alternately appear at each band edge.

As explained above, in the radial tyres of the present invention, at each edge of the band, the ends of the ribbons which are wound spirally to form the band, are shifted or spaced equally in the circumferential direction of the tyre. Therefore, fluctuation in the tyre circumferential direction of the tyre, of the rigidity at the tread edge is reduced, and tread uniformity is improved, and further durability and running stability are improved.

The above-mentioned shifting of ribbon ends can be applied to a band formed by plural wound ribbons discontinuous between the edges of the band. In this case, for example, the ribbons can be wound starting from both of the tread edges E1 and E2 to the tyre equator C. The ribbon ends are equally shifted in the circumferential direction of the tyre at each tread edge as explained above, and at the tyre equator the ends of the ribbons on one side of the equator are preferably joined with those of the ribbons on the other side of the equator. Therefore, it is not always necessary to shift the ends at the tyre equator.

TABLE 1

		Ex. 1	Ex. 2	Ex. 3	Ex. 4	Ref. 1	Ref. 2	Ref. 3	Ref. 4
5	Carcass	11 ply							
	Cord	Nylon (840d/2)							
	Cord Angle	90 degrees to tire equator							
10	Band								
	Cord	Aromatic polyamide (1500d/2)							
	Topping rubber	100% modulus = 50 kgf/sq.cm							
15	No. of Ribbon	2	4	4	2	1	1	1	2
	No. of Cord/Ribbon	1	1	2	2	1	2	1	2
	Winding Method *1	2SC	4SC	4SC	2SC	1C	1C	1C	2SD
20	Breaker	non	non	non	non	non	non	2ply	2ply
	Cord							Nylon	Aromatic
								1260d/2	Polyamide
	Cord angle							13 deg.	20 deg.
25	Test Results								
	Durability	105	105	105	103	100	100	105	105
	Wear Resistance	105	105	103	105	100	100	110	110
	Ride comfort	105	110	108	105	100	100	100	100
	Maneuverability	110	115	110	105	110	110	80	80
	Chamber Stiffness	120	120	120	120	120	120	100	100
30	Band making Time	100	50	25	50	200	100	200	50

\*1)

2SC: winding two ribbons simultaneously and continuously from edge to edge

4SC: winding four ribbons simultaneously and continuously from edge to edge

1C: winding one ribbon continuously from edge to edge

2SD: winding two ribbons simultaneously, but each from center to each edge

## Claims

1. A radial tyre comprising a toroidal carcass (6) extending between beads (4) and turned up around bead cores (5), and a belt reinforcement disposed radially outside the carcass (6) and inside a tread (2), characterised in that said belt reinforcement comprises a band layer (7) formed by plural ribbons (10) of rubber in which one cord or two parallel cords are embedded, the ribbons (10) being wound spirally and arranged side by side, the ends of the ribbons (10) being located at the edges (P,Q) of the band layer (7), and at each of said edges (P,Q) of the band layer (7) the ends of the ribbons (10) being shifted or spaced apart equally in the circumferential direction of the tyre.
2. A tyre according to claim 1, characterised in that the ribbons (10) are wound continuously from one edge (P or Q) to the other edge (Q or P) of the tread (2).
3. A tyre according to claim 1, characterised in that said belt reinforcement is composed of only said band layer (7).
4. A tyre according to claim 1 or 2, characterised in that said belt reinforcement further comprises a breaker (8) comprising at least two plies with the cords of one ply carrying the cords of the other ply and said band



layer (7) is disposed radially outside the breaker (8).

5. A tyre according to any of claims 1, 2 or 4, characterised in that said belt reinforcement further comprises a second band layer formed radially outside the first radially inner band layer (7) by winding ribbons spirally, and the ends of all of the ribbons in the second outer and first inner band layers are equally shifted or spaced apart around the tyre axis at each tread edge (P,Q).
6. A tyre according to claim 5, characterised in that the winding direction in the outer band layer is reversed to that in the inner band layer (7).
7. A tyre according to claim 6 or 7, characterised in that at each tread edge (P,Q), the ends of the ribbons (10) in the inner layer and the ends of the ribbons in the outer layer appear alternately.



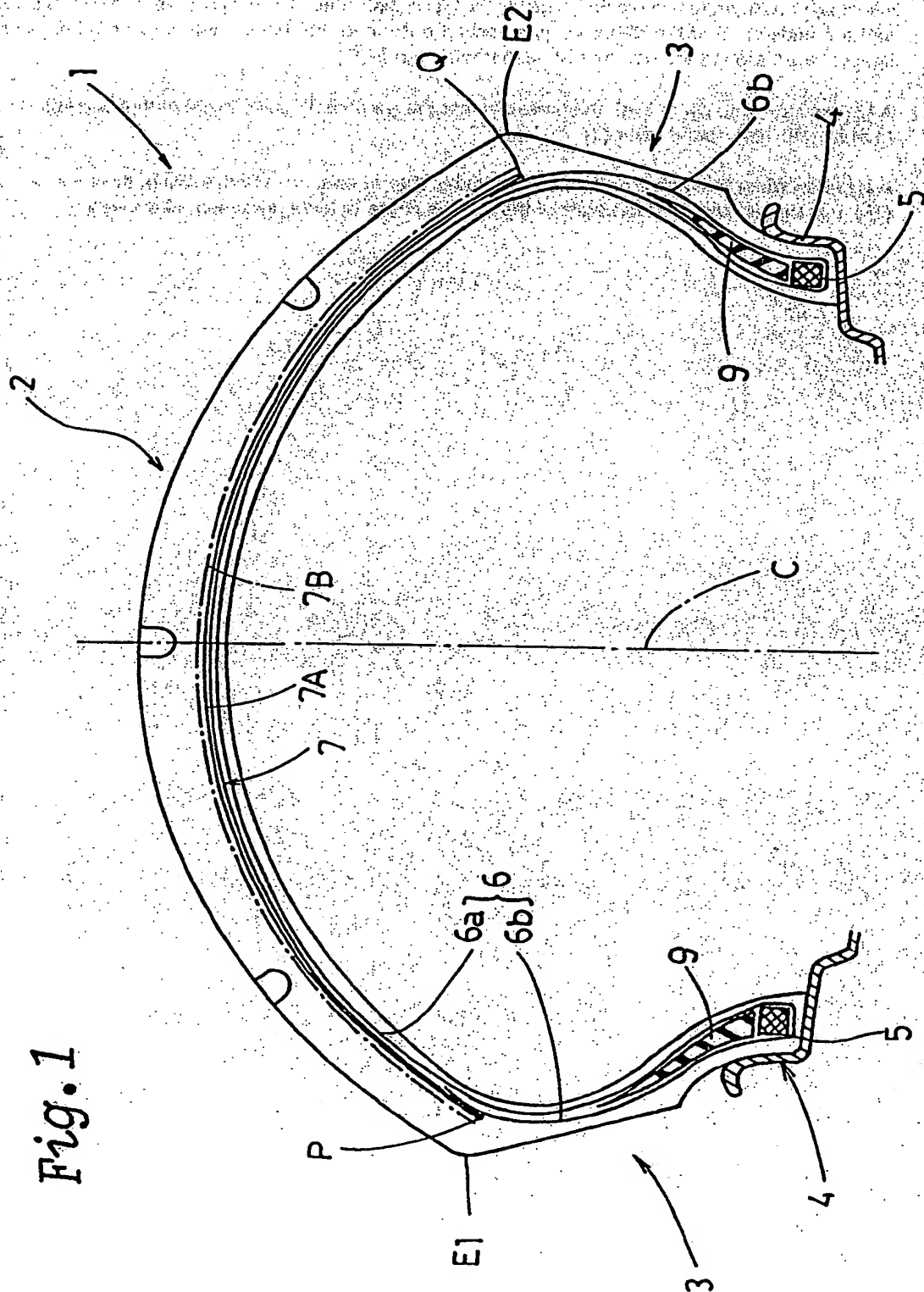


Fig. 1

Fig. 2

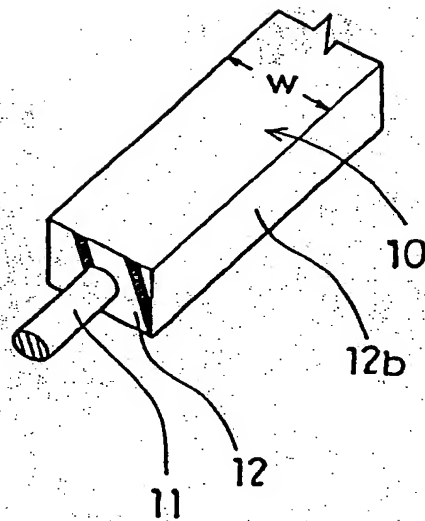


Fig. 3

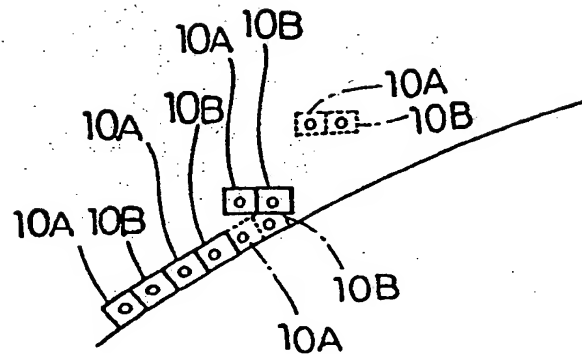


Fig. 4

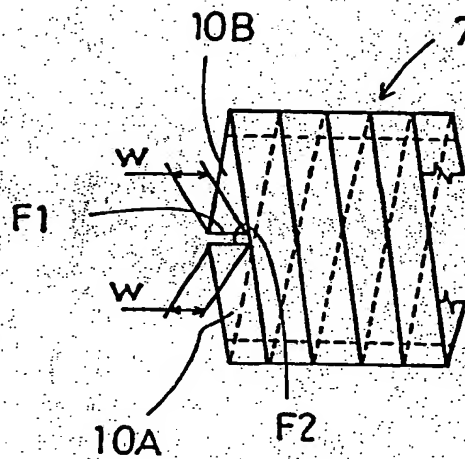
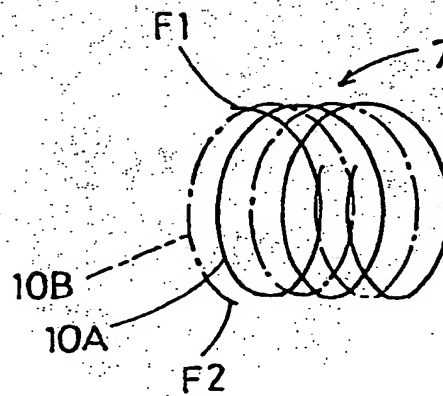
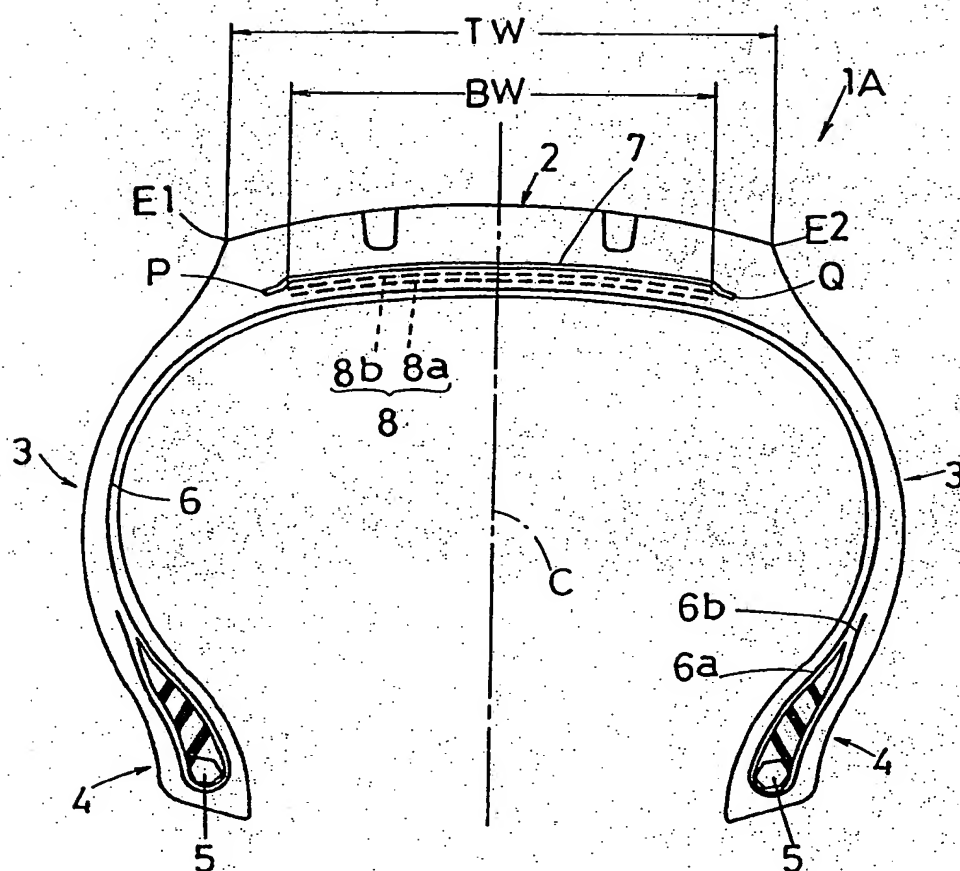


Fig. 5





*Fig. 6*